Railroad Truss Float-in

Description

During construction of the proposed lock and guide wall, the proposed highway and railroad bridges are to be built and put into operation. As part of the construction of the proposed railroad bridge, the truss that is to span the downstream navigation approach to the existing and proposed locks is to be built remotely then moved into position. The truss is to be built in the left bank boat basin, which will be enlarged along the upstream side to a total width of approximately 350 ft. The truss is to be constructed on temporary bents placed in the basin. When construction is completed and flow conditions are within the specified limits of discharge and stage as defined by the Nashville District contract specifications, two barges, each 160-ft long and 54 ft wide, will be brought into the basin, positioned near each end of the truss, and partially filled with water to weigh them down. A set of temporary bents will be constructed between the barges and the truss. When this is completed and flow conditions are within specified limits, the water will be pumped from the barges and the truss will be lifted free from the construction bents. A towboat is to be placed on each barge and the barges are to be backed out of the basin sufficiently to allow the connecting member between the head of the two barges to be reattached after the head of the barges are channelward of the construction bents. The barge/truss configuration will then be backed out into the channel. The barge/truss configuration must be rotated to face upstream, move from the left descending bank line toward the right descending bank line, steer around the existing mooring cells immediately downstream of the powerhouse island, and move into position between the bridge piers. Once in position, the barges will again be filled with water and the truss will be set onto the bridge piers, one on the powerhouse island and the other landward of the proposed guide wall. Also, a high-tension powerline spans the river approximately 600 ft downstream of the boat basin. The height of the barge/truss configuration will be sufficient to strike the lowest point on these powerlines, therefore the configuration must be turned and the downstream drift with the current stopped before the truss reaches the powerlines.

To determine how this maneuver could be performed and the difficulties that might arise in performing the maneuver, a simplified scale replica of the barge/truss configuration was constructed and the left bank boat basin was enlarged to specifications received from the Nashville District in September 2000. The barges were built to the correct dimensions and the bents that would support the truss were installed in the correct position within the barge and in the correct position on the truss. The replica of the truss was with a rectangular beam having the correct width and length dimensions and weighted sufficiently for the barges to draft the specified 7 ft. Two radio-controlled model towboats, one for each barge, were used and were independently operated. The features of this plan were illustrated in Figure 20.

The flow conditions under which the barge/truss configuration was to be moved are limited, especially the tailwater elevation. If the tailwater is too low, the truss cannot clear the top of the bridge piers and the channel near the entrance to the boat basin will

require dredging to remove some shallow areas. Dredging is to be avoided due to the environmental impacts on adjacent mussel beds. If the tailwater is too high, the truss cannot be lowered sufficiently to put it into place once it was in position in the lock approach. To achieve the correct tailwater elevation, it was proposed that the truss be placed during low-water season. To regulate the tailwater elevation, the upper pool at Lock & Dam 52 on the Ohio River can be raised or lowered and the flow through the powerhouse at Kentucky Lock & Dam can be increased or decreased temporarily or a combination of both. The absolute conditions that might exist at the time of the truss placement were unknown; therefore, a range of flow and tailwater conditions was provided to ERDC.

The flow conditions that were provided by the Nashville District for evaluation of the truss float-in are as follows:

a. 301.5 ft tailwater (slack flow), increase powerhouse discharge as necessary to raise tailwater elevation to 303.0'
b. 303.0 ft tailwater (slack flow), no discharge through powerhouse or dam
c. 300.0 ft tailwater (slack flow), increase powerhouse discharge as necessary to raise tailwater elevation to 303.0'.
d. 306.0 ft tailwater with 75,000-cfs discharge, reduce powerhouse discharge to lower tailwater elevation to 303.0'

The model was calibrated to determine the discharges through the powerhouse necessary to obtain the specified tailwater elevations. Once these flow conditions were calibrated, current directions and velocities were obtained. After collection of current directions and velocities, a beam was placed across the model to mark the position of the high-tension powerlines. The overhead tracking system was used to track the model barge/truss configuration as it was maneuvered from the boat basin until it reached a position in alignment with the railroad piers in the lock approach. Also, the operation of the model barge/truss configuration was videotaped as the maneuver from the boat basin to alignment with the railroad bridge piers was performed for each flow condition.

For flow conditions c and d, the strength of the current immediately outside of the boat basin pushed the barge/truss configuration to the downstream edge of the basin before it could be backed from the basin. Two approaches to controlling the downstream set of the barge/truss configuration before it could be backed from the basin were evaluated. The first approach was to connect lines to the head and the stern of the upstream barge. These lines were slowly released to keep the configuration from being set downstream before the configuration was out sufficiently far from the boat basin to start rotating, and then completely released when the configuration started rotating. The second approach was to install a single piling at the downstream channelward corner of the boat basin. This piling could be used to hold the configuration in place and as a pivot for the downstream barge to work from as the configuration rotates. Since the amount of current set for flow conditions a and b was small enough that the barges could be backed out with danger of setting into the downstream edge of the basin, the lines holding the

configuration in place for these flow conditions was completely released as the towboats started backing.

Results, navigation conditions.

Current directions and velocities. 301.5 to 303.0 tailwater (TW)– Currents tended to cross from about two-thirds of the length downstream along the west edge of the powerhouse island toward the left descending bank line, reaching the left descending bank line about 500 ft upstream of the upper end of the boat basin, then turn directly downstream (Plate 124). The current still slightly angled toward the left descending bank line as they passed the boat basin. The velocities just outside the basin ranged from 1.6 to 3.4 fps. A large area of almost slack current extended from midchannel to the right bank and up into the lock approach.

303.0, no flow – The model was not designed to hold a flat pool with no discharge, so enough flow was passed through the powerhouse to maintain the required pool, and so there was some flow and velocities. The current direction was similar to that of the previous flow condition (Plate 125). Velocities immediately outside the boat basin were from 0.8 to 1.1 fps and the area of almost slack velocities was slightly larger than the previous flow condition.

300.0 to 303.0 TW – The currents tended to cross the channel starting about two-thirds of the length downstream of the powerhouse island and reaching the left descending bank line at the upstream edge of the boat basin (Plate 126). The currents out into midchannel directly outside the boat basin still tend to be angled toward the left descending bank line. The velocities immediately outside the boat basin ranged from 2.4 to 4.5 fps and the slack water area extended from the right bank to about 40 percent of the total distance across to the left bank and ended about 200 ft downstream of the end of the guide wall.

306.0 to 303.0 TW – The currents angled across the channel from about two-thirds of the length downstream of the powerhouse island and reached the left descending bank line about 500 ft upstream of the upper end of the boat basin (Plate 127). The currents along the left bank tended to parallel the bank but out in the channel they tended to be angled slightly toward the left bank. The velocities immediately outside the boat basin ranged from 3.9 to 4.8 fps and the slack water area was confined from the right bank line out to about 25 percent of the total width of the channel and back into the lock approach.

Tow tracks.

301.5 to 303.0 TW – Both towboats backed their engines to start the barges out of the basin (Plate 128). As the barges cleared the basin, the current push on the most upstream barge and towboat caused the barge/truss configuration to rotate counterclockwise. The left side towboat then changed direction of the engine to start driving. This was done to control the rate of rotation of the barge/truss configuration. The right towboat continued backing slowly to move out into the channel. As the configuration rotated sufficiently that it was facing upstream, the right towboat started driving forward. The left side

towboat applied more engine power to stop the rotation of the barge/truss configuration. As the rotation was stopped, the engine power to both towboats was balanced so that the configuration moved slowly forward. The barge/truss configuration was rotated slightly toward the right descending bank line and the current caused the configuration to slide toward the right bank. It was not difficult to slide toward the right bank sufficiently to get landward of the old mooring cells downstream of the powerhouse island. By this point, the configuration was in mostly slack currents and it was not difficult to move up into the lock approach and position the truss.

303.0 TW, no flow – Both towboats backed their engines to start the barges out of the basin (Plate 129). As the barges cleared the basin, there was little current to assist in the rotation of the barge/truss configuration or to set the configuration downstream into the powerline. The left towboat continued to back until the rotation to alignment upstream was about half complete, then the engine direction was changed to forward to slow the rate of rotation. The engine of the right towboat was brought forward as the rotation to face upstream was completed. With little current to help the configuration slide, the configuration had to be rotated slightly toward the right descending bank line and the towboats were driven and steered left to get landward of the mooring cells. Once the configuration was between the right bank and the mooring cells, it was not difficult to move into the lock approach and position the truss.

300.0 to 303.0 TW, with lines – Both tows were backed slowly (Plate 130). The barge/truss configuration tended to try and rotate counterclockwise. The right side towboat used its left flanking rudder to counteract this rotation and keep the lines taut. The bowline was held and the stern line slowly released so the barge/truss configuration pivoted off the upstream line. As the head of the barges neared the entrance of the boat basin the stern line was released, the right towboat was backing slowly and the left tow was driving slowly. As the head of the upstream barge got about 20-30 ft outside the basin, the line on the head of the barge was released. The configuration immediately started drifting downstream and rotating. The right towboat engine was brought ahead to help hold the position on the right side and the left towboat engine was brought ahead to control the rate of rotation. As the configuration turned sufficiently to be facing directly upstream, both towboats increased power to stop the current set downstream. As the configuration was rotated slightly toward the right descending bank line, the tow slid easily and was not difficult to get landward of the mooring cells. Once between the mooring cells and the right bank, the configuration was not difficult to maneuver into the lock approach and into position for the truss.

300.0 to 303.0 TW, with piling – Lines were placed on the head and stern of the upstream barge to hold it in place until the barge/truss configuration was ready to be backed out (Plate 131). When ready, the lines were released and the right towboat backed slowly. The current caused the configuration to start rotating counterclockwise. The right side barge backed alongside the piling and the configuration pivots around the piling. The left towboat engine was brought ahead immediately to control the rate of rotation of the configuration. The configuration pivoted off the piling and was set downstream. As the head of the downstream barge cleared the piling, the right towboat engine was brought

ahead to help control the rate of the downstream set. As the configuration rotated sufficiently to be facing directly upstream, the engine power of both towboats was increased to stop the downstream set and gain forward momentum. The tow was turned slightly toward the right descending bank line and the configuration slid easily toward the right bank. Maneuvering landward of the mooring cells, into the lock approach, and into position for the truss was not difficult.

306.0 to 303.0 TW, with lines – The maneuver using the lines was similar to that described for the 300.0 to 303.0 TW condition (Plate 132). The current set was greater and it proved to be more difficult to get the barge/truss configuration out of the boat basin. The downstream set of the current pushed the configuration downstream before rotation could be started. Turning the configuration before reaching the powerline required that the configuration be rotated faster than that done with the 300.0 to 303.0 TW condition. Once the rotation was completed and the downstream set stopped, maneuvering the configuration around the mooring cells and into position for the truss to be set was not difficult.

306.0 to 303.0 TW, with piling - The maneuvers with the piling were similar to that performed with the 300.0 to 303.0 TW condition (Plate 133). The barge/truss configuration rotated off the piling and out into the channel with little difficulty, control of the downstream set and the rate of rotation were easy, and sliding the configuration landward of the mooring cells and into position to set the truss was not difficult.